

*Washington.*—The mean temperature was 36.7°, or 3.7° below normal; the highest was 70°, at Elma on the 2d and at Sunnyside on the 25th. The average precipitation was 4.53, or 0.89 above normal; the greatest monthly amount, 12.32, occurred at Lapush, and the least, 0.15, at Ellensburg.—*G. N. Salisbury.*

*West Virginia.*—The mean temperature was 46.1°, or about 5.0° above normal; the highest was 81°, at Huntington on the 20th, and the lowest, 12°, at Beckly on the 1st. The average precipitation was 3.60, or 0.50 above normal; the greatest monthly amount, 6.52, occurred at Elkhorn, and the least, 1.33, at Burlington.—*H. L. Ball.*

*Wisconsin.*—The mean temperature was 26.7°, or 0.6° below normal; the highest was 71°, at Butternut on the 30th, and the lowest, 27° below zero, at Grantsburg on the 18th. The average precipitation was 2.48, or 0.87 above normal; the greatest monthly amount, 4.83, occurred at Milwaukee, and the least, 1.30, at Koepenick.—*W. M. Wilson.*

*Wyoming.*—The mean temperature was 26.0°, or 8.0° below normal; the highest was 74°, at Fort Laramie on the 27th, and the lowest, 29° below zero, at Sheridan on the 13th. The average precipitation was 1.72, or 0.18 above normal; the greatest monthly amount, 4.23, occurred at Laramie, and the least, 0.35, at Wise.—*M. G. Renoe.*

## RIVER AND FLOOD SERVICE.

By PARK MORRILL, Forecast Official, in charge of River and Flood Service.

The month has been signalized by the development of one of the worst floods ever known in the lower Mississippi Valley; at its close the river has just begun to fall from Cairo to Memphis and is still rising from Helena southward. The flood waters came chiefly out of the lower Ohio, only a moderate flood prevailing in the upper Ohio, and the Mississippi above Cairo remaining well below the danger lines of the gauges. Heavy and continued rains in Tennessee, Kentucky, and adjoining States caused unprecedented floods in the Cumberland and Tennessee rivers, which continued from the 10th to nearly the close of the month. These waters were poured into the lower Ohio, which was already well filled by the waters from its upper reaches. At Cairo the month opened with the river 1.1 foot above danger line and there was a steady rise to a stage 10 feet higher on the 25th. At Memphis the river rose to 4.1 feet above danger line on the 19th, when the breaking of the levees checked its rise and it remained nearly stationary to the end of the month. The cessation of rise at Memphis does not indicate the passage of the flood crest, as is shown by the continued rise at Cairo. The rise at Helena continued, in spite of vast overflows, to the end of the month, when the water was 6.9 feet above danger line. At Arkansas City the rise was checked at 9.9 feet above danger line on the 29th. At Vicksburg and New Orleans the rise continued to the close of the month, at which time the stage was 8.4 feet above danger line at Vicksburg and 1.1 foot at New Orleans.

On the 15th the Weather Bureau issued a warning that "the impending flood will prove very destructive in Arkansas and northern Louisiana." Further warning was given on the 19th that "the floods in the lower Mississippi during the next ten days or two weeks will in many places equal or exceed in magnitude and destructiveness those of any previous year, and additional warning is given to the residents of the threatened districts in Arkansas, Louisiana, and western Mississippi to remove from the region of danger." These warnings were supplemented by further bulletins descriptive of the progress of the flood.

The following résumé of river stages and conditions of navigation in the respective streams is compiled from reports by the officials of the Weather Bureau at various river stations and section centers:

*Hudson River.* (Reported by A. F. Sims, Albany, N. Y.)—At the beginning of March an average of 15 inches of snow covered the forest section of the Hudson watershed, while over the plateau region and valley districts only scattered drifts remained. The ice in the Mohawk and other tributaries of the Hudson was from 12 to 14 inches thick. In the upper Hudson, above the State dam, the ice was from 15 to 22 inches thick, while that of the tidewater portion of the river ranged from 15 inches at Troy to 5 inches at Catskill, and open water was to be seen at points here and there from Poughkeepsie south. On the 2d of March the steamer *Norwich* opened navigation between Newburg and New York by bringing a tow into Roundout Creek. During the early days of the month copious rains melted much of the snow on the upper Hudson watershed, so that by the 9th only drifts remained. On the 6th the Mohawk River rose and the ice below the Adams Island Bridge broke up. The ice in the vicinity of Albany became loosened

from the shore in many places and disappeared entirely below the Greenbush Bridge, leaving two-thirds of a mile of open water, and by forming a gorge at Downs Point caused a slight freshet. The ferryboat *Transport* resumed her regular trips between Rhinecliff and Kingston on the same day. A rapid rise in the Hudson was observed on the 8th, which continued from the early morning up to 9 a. m., when the rise was checked. By the 9th the Mohawk River began to fall, but was still 5 feet above the normal, and the Hudson was 2 feet above the normal. The ice from the upper Hudson jammed at points between Troy and Catskill.

On the 11th the Mohawk River was practically clear of ice from Fonda to its mouth; the ice which came down into the Hudson was from 12 to 16 inches thick. On this date the first boat this season made her appearance on the river at Albany. On the 12th the steamer *Evans* of the Castleton Line went down the river and met very little ice between Albany and Castleton. The People's Line steamer *Drew* arrived at her wharf in Albany from New York on the morning of the 16th, the first through boat from New York; the *City of Troy* passed up in the wake of the *Drew* to the head of tidewater navigation. By the 23d there was practically no snow over the watershed of the Hudson; the river stage was 7 feet above the normal. The cold wave of the night of the 25th checked the flow of surface water, and as a result a fall of 1 foot in the river was recorded on the morning of the 26th. At the close of the month a normal volume of water flowed in the Hudson at Albany, and the opening of navigation in 1897 will go into history as one of the most favorable that this section has ever known. It is a pleasure to state that the public confidence in our reports and forecasts was so great that merchants and others having perishable property in the low-lying portions of Albany and vicinity did not make a move to place their goods above the freshet line.

*Susquehanna River and branches.* (Reported by E. R. Demain, Harrisburg, Pa.)—No damaging floods occurred during the month but the stages of water in most streams of the system averaged higher than for several months, and at Harrisburg the average gauge reading was higher than during any month since April, 1896. On the West Branch of the Susquehanna the ice disappeared from Driftwood Creek at Cameron on March 2, and at Farrandville no ice was reported after the 3d. At Sinnamahoning the water was below the zero of the gauge until the 4th, when a stage of 4 feet was reported, and on the 6th the highest stage during the month, 6 feet, occurred. At Renova the river rose 6 feet from the 2d to the 7th, reaching on the latter date the highest stage of the month, 8.5 feet. At Cedar Run, on Pine Creek, the water was below the zero of the gauge all the month, except on the 12th and 13th, and again from the 21st to the 26th, the highest stage reached being 1.7 feet of the 24th.

On the North Branch the ice broke up at Towanda on the 4th and moved out during the night on a rise of about 3 feet, and floating ice was last observed in the river at that point on the 7th. The ice along the shore at Wilkesbarre began to break up on the 1st, and the river was clear on the 3d, but floe ice was reported subsequently and the river was not entirely free from ice until the 10th. Huntingdon and Mifflin, on the Juniata, report good stages of water during the entire month, ranging from 4 to 10 feet. At Harrisburg the maximum gauge reading noted was 11.5 feet on the 26th, the highest point touched since April 4, 1896.

Watermen report the outlook for rafting on the Susquehanna as very encouraging, and it is expected that a large amount of timber will be floated to market this season. It is estimated that at least 200 more rafts will be floated this spring than last season, provided the requisite stages of water are maintained. A large number have already passed down. On the 11th and 12th sixteen rafts passed Harrisburg, containing about 90,000 cubic feet of timber. One of the largest rafts ever seen on the river arrived at Lockhaven, on the West Branch, a few days since. It was 354 feet long and contained about 80,000 feet. Forty-three rafts were reported in the dam at Lockhaven at the close of the month ready to move out on the next flood.

*Rivers of South Atlantic States.* (Reported by E. A. Evans, Richmond, Va.; C. F. von Herrmann, Raleigh, N. C.; L. N. Jesunofsky, Charleston,

S. C.; D. Fisher, Augusta, Ga.; and J. B. Marbury, Atlanta, Ga.)—Low water prevailed during the entire month over the watershed of the James River. On the 14th a slight rise set in but was unimportant, the maximum height reached being only 3.7 feet above the zero of the gauge at Richmond. The river then remained stationary until the 23d when it began to decline. Rains were quite frequent over the James basin, but the quantity deposited was not sufficient to produce any marked changes in the height of the stream.

The high stages in the rivers of North Carolina obtaining at the end of February were maintained throughout the first and second decades of March by the continuous but fortunately not excessive rains. There was a gradual and steady rise in the Cape Fear and in the Roanoke from the 6th to the 17th, just reaching the danger line at Weldon and Fayetteville, but beyond keeping lowlands too wet for plowing no damage resulted. An equally steady decline in all the rivers set in on the 20th and continued to the end of the month, when the stages were about the average for the season of the year.

There were two periods of freshets in the streams of South Carolina during the month. In the western section high waters occurred between the 6th and 9th and between the 11th and 18th; in the eastern section from the 1st to 11th and between the 15th and 29th. The rivers were above the danger lines on the various gauges as follows: at Camden on the 8th and 14th to 17th; at Cheraw on the 8th, 9th, and 14th to 17th; at Conway on the 2d to 11th; at Effingham on the 1st, 2d, and 21st to 23d; at Fairbluff on the 1st to 6th; and at Smiths Mills on the 2d to 6th and 16th to 28th.

The South Carolina streams were navigable throughout the entire month. More timber and plank rafts were floated down in March than during the entire logging season previously. On the Waccamaw, the Black, the Edisto, the Pedee, the Lynch, and the Little Pedee, they were reported as passing in great numbers almost daily. Freight in large quantities was also shipped, including more fertilizers than for many years past. There was little damage reported from overflow or washouts on highlands. At Cheraw on the 8th and 16th there was slight damage to the oat crop from flooding of lowlands. A few cattle were drowned in the lowlands at St. Stephens from the 22d to the 26th. The continued freshets in the lower sections during February and March have seriously interfered with work on the rice lands which can not be drained for preparation of the soil. In consequence rice planting will be delayed from fifteen to twenty-five days. Many planters are contemplating the use of turbines and steam pumps to drain their rice lands.

The Savannah River was at its best for navigation purposes from the 1st to the 7th, and from the 18th to the end of the month, while from the 8th to 17th there was too much water to permit the maintenance of regular boat schedules. The rainfall over the watershed was unusually heavy during the month, but fortunately no concentrated periods of heavy rain prevailed, except from the 12th to 14th; from the effects of the latter the river advanced close to 13 feet at Augusta. The decline afterwards was less rapid than usual, due to the almost daily addition of light rains.

The excessive rains at various periods during the month caused some serious rises and damage to property on several of the Georgia rivers. The period of heaviest rainfall was between the 5th and 15th in the northern section and between the 19th and 22d farther south. The water was above the danger line on the Oostanaula River at Resaca on the 15th and 16th; on the Ocmulgee at Macon on the 13th, 14th, and 15th; on the Chattahoochee at Eufaula on the 15th, and 23d to 26th; at Columbus on the 14th and 15th. At Eufaula the stage was 50 feet on the 24th, which is the highest since 1888, when 60 feet was reached. A rainfall of 8.27 inches occurred between 4.45 p. m. on the 21st and 12.30 a. m. on the 23d, and the river rose 30 feet in twenty-four hours.

*Mobile River and branches.* (Reported by F. P. Chaffee, Montgomery, Ala., and W. M. Dudley, Mobile, Ala.)—Navigable stages prevailed in the Alabama and tributaries during the entire month. Very heavy rainfalls on the 6th, amounting to 8.06 inches in twenty-four hours at Selma, 4.82 at Montgomery, and 6.94 at Wetumpka, with general but not so heavy rainfall over the northern portion of the watershed, caused sudden and rapid rise in the rivers. Heavy and general rains at intervals caused a continuance of the high waters throughout the month. It was slightly above danger line at many stations and reached 41.5 feet at Selma on the 26th. Lowlands were generally overflowed, and from the 15th to 25th steamers refused freight for any but high-water landings.

The Tombigbee River and its tributaries were falling up to and including the 5th; on the 6th general and excessive rains fell over the State, the least reported being 1.20 inch at Warrior on the Black Warrior River. These excessive rainfalls flowed off rapidly into the rivers, causing decided rises by the morning of the 6th at all points. The rise at Tuscaloosa, Ala., was 38.5 feet, and gave a stage of 54.8 feet; the river rises very rapidly at this point, owing to its narrowness and the steepness of its banks. The rains which occurred at short intervals have kept the rivers at high stages throughout the month and navigation has been an easy matter; a large shipping business has been done which is gratifying to river men, whose boats were tied up during the unusually low water of the winter just passed.

*Ohio River and branches.* (Reported by F. Ridgway, Pittsburg, Pa.;

H. L. Ball, Parkersburg, W. Va.; S. S. Bassler, Cincinnati, Ohio; F. Burke, Louisville, Ky.; and P. H. Smyth, Cairo, Ill.)—On March 1 from 1 to 2 inches of snow remained on the ground over the greater part of the watershed of the Alleghany River and its tributaries. The mild temperatures during the first week of the month caused this snow to melt and, supplemented by the general rains which fell over western Pennsylvania at the same time, caused flood conditions in the Alleghany River on the 6th of the month. The Alleghany River reached the danger line (22 feet) about 7.30 p. m. of the 6th, at which time it was still rising at the rate of 1.5 inch per hour at Herrs Island Dam. The Monongahela River reached a maximum stage of 19.0 feet at 9.30 p. m., caused entirely by backwater from the Alleghany. Quantities of slush ice passed out of the Alleghany River during the evening. The storms of the entire month were attended by warm conditions and general rains, causing high water most of the time. Increased activity in all river interests resulted, especially among the packet operators.

General and somewhat heavy rains fell from the 4th to the 6th over the northern part of West Virginia. The rivers of that section responded quickly and a rise occurred which caused some uneasiness along the Ohio below Wheeling. The flood, however, was light and caused no damage. The crest, with a stage of 30.3 feet, passed Parkersburg on the morning of the 8th. From that time until the 19th the Ohio and its West Virginia tributaries fell slowly, but maintained good stages. Continuous rains from the 18th to the 26th again started a rise in the rivers, but it was slight.

The makeshifts employed by the railroads at Cincinnati during the prevalence of the flood of the latter part of February were abandoned at the beginning of the month and freight and passenger traffic returned to the customary depots. River business was extraordinarily active; wharves and wharf boats were crowded to their utmost capacity with freight for shipment on the fine stage of water. On the 4th unprecedented rainfalls occurred, causing a tumultuous rush of water in the small streams around Cincinnati and rapidly bringing about a local flood of a much more destructive character than that of the preceding month. All the valleys on the northern side of the Ohio were inundated; railroads suffered washouts and other damage; buildings, bridges, and other property were swept away and many towns largely submerged. At Cincinnati the Ohio suddenly responded to the extraordinary rise of the usually sluggish and unimportant streams and rose very rapidly. The river came to a stand at 43.2 feet at 8 a. m. on the 6th. On the 8th the river began rising again, with prospect of another serious freshet. The water passed the danger line (45 feet) at 10 p. m. on the 9th. Cellars of business houses in the bottoms were again flooded by backwater from the sewers, but timely warnings had been given and no serious loss was sustained. The water rose to 50.1 by 8 p. m. of the 11th, where it remained stationary until 2 p. m. of the 12th, after which it fell very slowly throughout the remainder of the month.

The month opened with a depth of 34.6 feet of water in the canal at Louisville. This was rapidly reduced until the 11th when the stage of water had fallen to the danger line, near which it remained until the 15th. After this date it fell rapidly, and on the 31st had reached an average stage. The excessive rains of the 5th and 6th swelled the smaller tributaries of the Ohio, especially those coming in from the northern side of the stream, and resulted in great damage to railroads through washouts, impeding and in some instances causing the complete suspension of traffic to all northern points for more than a week. It was not until toward the close of the month that traffic was fully resumed over all the lines entering Louisville.

At Evansville, Mount Vernon, and Cairo the river was above the danger line the entire month. At Paducah the danger line was passed on the 2d and the river continued above it to the close of the month. The maximum stage reached at Paducah was 50.9 feet on the 24th, five days after flood warnings had been issued by the Weather Bureau. At Cairo the maximum stage reached was 51.6 feet on the 26th, the highest point reached since February, 1884. All the lower portions of Paducah were submerged but no houses of any account were destroyed or materially damaged. A few shanty boats in the locality known as "Dogtown," in the vicinity of Paducah, were sunk or washed away. The farmers, being forewarned by the Weather Bureau, removed their stock and produce to places of safety.

Although no breaks have occurred in the levees protecting Cairo, seep water, augmented by rains and waste water since the closing of the sewer outlets, has increased until, at the close of the month, it is within 10 inches of the sidewalks of the graded streets. Many one-story houses in the lower portion of the city have had to be vacated. The several railroad companies centering at Cairo have been put to considerable expense protecting their properties; settling of embankments, washing of levees, and overflowing of tracks have been of frequent occurrence. Thousands of sacks of sand have been used to repair embankments, etc. The farming interests will suffer greatly, all the bottoms not protected by levees being submerged.

*Tennessee and Cumberland rivers.* (Reported by L. M. Pindell, Chattanooga, Tenn., and H. C. Bate, Nashville, Tenn.)—The month opened with the Tennessee falling from the headwaters to Bridgeport and rising over the lower river. General rains set in on the 2d, causing

the river to rise to 23.5 feet at Chattanooga on the 8th, when the rains became heavy and caused a further rise to 38.2 feet on the 14th; it then fell until the 19th, when heavy rains occurred again, causing the river to rise to 33.3 feet by the 22d. Never before in the history of the Tennessee River have there been four distinct rises inside of thirty days, or three rises to such high stage in any one month. During the high water special observations were obtained from all the river stations, and the information was thoroughly bulletined and given to the public. So complete was the warning that no loss, worth speaking of, occurred in Chattanooga; no one moved unnecessarily, and no one was compelled to move in water. The office force remained on duty from 7 a. m. of the 13th to 11 p. m. of the 14th, taking frequent readings of the river and posting them in the flooded districts. Between the headwaters and Bridgeport the highest water occurred between the 10th and 11th; between Florence and Paducah from the 19th to 31st. At Florence the river reached 32.5 feet at midnight on the 19th, which exceeds all previous rises. At Lower Muscle Shoals the water was over the gauge from the 20th to 24th. On the 19th the operator at Riverton Junction sent word that he could not raise Riverton as the telegraph wires were under water. Over the lower river from Florence to Paducah the flood has no equal, higher stages being reached than during any previous flood as far as known.

The tributaries were navigable during the entire month but at and below Chattanooga navigation of the Tennessee was impeded by high water from the 17th of the month, as landings could not be made safely. After the 25th navigation was resumed down the river as far as Florence. The high and back waters have flooded lowlands and retarded planting of crops. Considerable damage to small bridges and railroad trestles along the lines of small streams occurred near Knoxville. At Florence, on the morning of the 19th, the river was 31.6 feet; both the Memphis and Charleston Railroad and the Louisville and Nashville Railroad tracks were under water between the bridge and the depot. Traffic by road and rail between Florence and Sheffield was cut off by water. The rain which began on the 2d continued up to the 23d, with slight intermission.

At the beginning of March the Cumberland River was falling steadily throughout its length. General and copious rains on the 2d and 3d started a rise in the upper divisions on the 4th and lower on the 6th which continued practically without interruption until the 17th to 20th, and gave one of the longest periods of high water known in years and caused an immense loss to business interests. The danger line was passed at Carthage on the 10th and Nashville on the 14th, and the maximum of 46 feet was recorded at Carthage on the 16th and that of 49 feet at Nashville on the 20th. This is the highest water at Nashville since March 14, 1891. After the 20th the fall was steady and rapid in the upper sections but moderate in the lower river, and the month closed with the lowest water of the month but plenty for navigation.

*Mississippi River and minor branches.* (Reported by P. F. Lyons, St. Paul, Minn.; M. J. Wright, Jr., La Crosse, Wis.; F. J. Walz, Davenport, Iowa; F. Z. Gosewisch, Keokuk, Iowa; H. C. Frankenfeld, St. Louis, Mo.; S. C. Emery, Memphis, Tenn.; R. J. Hyatt, Vicksburg, Miss.; R. E. Kerkam, New Orleans, La.; and C. Davis, Shreveport, La.)—The Mississippi River at St. Paul remained frozen until the 27th, when the ice began to weaken and move out, and by the 29th the river was practically open. River gauge readings could not be accurately made until the 20th; prior to this date, from observations of the ice field and other conditions, the average stage of water was estimated to be about 2.7 feet on the gauge. On the 20th the ice had sufficiently melted along the bank near the gauge to admit of accurate readings and so the regular record was commenced on that day with a gauge reading of 3.9 feet; a steady rise of nearly a foot a day followed to the morning of the 31st, when 13.5, or 0.5 of a foot below danger line, was registered. The prospect for a flood has commenced to excite some alarm among dwellers in the flats about the river front. The high water was evidently due to the melting of snow and ice along the watersheds of the Minnesota and that portion of the upper Mississippi extending half way from St. Paul to its source. During the early part of April it is usual to get the rest of the snow water that further adds to the flood, but most of the water so far is evidently due to the discharge from the Minnesota River.

At La Crosse the channel of the Mississippi was free from ice a considerable portion of the month, although on the 18th the average thickness of the ice was 5 inches. The ice was cut from the piers of the Mississippi wagon bridge on this date as a precautionary measure, and the river gauge readings were also resumed at the same time. On the 18th and 19th Root River reached an unusually high stage, overflowing in places and damaging some buildings, crops, and live stock, and interfering with railroad traffic. The La Crosse River reached an unusually high stage during the middle of the month. It overflowed its banks in many places, the water covering some farming lands and bottoms. The high temperature of the 17th to 19th melted a large quantity of snow and ice, and, as the ground was frozen, most of the water found its way to the rivers. The ice broke up and began running in the Mississippi at 2 p. m. of the 29th. A considerable amount of logs and driftwood was in the river during the last days of the month. The river fell on the 28th and 29th, presumably due to an ice gorge above, but from noon of the 29th to 8 a. m. of the 30th it rose 1.3

feet. The overflow of the Black, La Crosse, and Root rivers, together with the running ice, did considerable damage to bridges and seriously crippled railroad traffic. On the 29th the ice was all out of the Mississippi River in front of La Crosse.

The ice went out at Davenport on the 11th, and at Dubuque on the 19th; it held in Lake Pepin until the end of the month. Navigation was opened to Davenport on the 22d, the first steamboat of the season leaving for Burlington on that date. By the end of the month navigation was opened as far north as Lake Pepin, though considerable floating ice was running in the river from La Crosse northward until the 29th and 30th. The gorge, formed early in the winter at the mouth of the Chippewa, went out the last of the month and carried with it three or four million feet of logs, which had been carried down the Chippewa at the time the gorge formed and been brought down by high water and collected there more recently. The month closed with the river at a good stage and rising.

Ice had ceased running at Keokuk on the 6th, but on the 13th heavy gorge ice began running, presumably from Burlington and Keithsburg, where the ice gorges were broken on the 12th. On the 16th navigation was opened by the steamer *Crescent City*, resuming regular trips to Quincy, Ill. A steady rise began in the Mississippi after March 9, which was increased after the 22d by a flood coming out of the Des Moines River which swelled the Mississippi south of the Des Moines, and overflowed exposed lowlands without doing any material damage. The highest stage was reached at Keokuk on the morning of the 28th.

There was still some ice running past Hannibal as late as the 16th; the last seen at St. Louis was on the 2d. Owing to heavy rains there was a steady rise in this portion of the river during the early days of the month, amounting to 9 feet at St. Louis to a stage of 21.0 feet on the 7th. From this time to the middle of the month the river fell. The rise of the latter half of the month overflowed the bottom lands from Keokuk to Alton. On the 24th the inhabitants of the lowlands near Quincy began to move out and precautions were taken to protect the Indian Grave levees. On the 25th the bottom lands below Louisiana commenced to be flooded and the people prepared to move to higher ground. On the 27th the Mississippi water backed into the Fox River and began to overflow lowlands about Alexandria, Mo. By the 28th most of the lowlands between La Grange and Hannibal, a distance of 38 miles, were flooded, as were also the bottom lands near Burlington and some farm lands on the Missouri side opposite Alton, Ill. On this date the river at Quincy was 7 miles wide. Farmers were devoting their time to moving and saving stock and great efforts were being put forth to protect the levees. Between the 28th and 31st there was a slight fall in the water and extreme danger was averted for the time. Under the influence of the same heavy rains the Illinois River was also decidedly at flood stage after the 18th, and in a few days was 3 miles wide at Beardstown and about as wide at Virginia. It had overflowed all lowlands to its mouth and was still at a very high flood stage at the close of the month.

From St. Louis to Cairo a good stage of water was maintained during the entire month. From Cairo to Memphis flood conditions prevailed nearly the whole time. The bottoms along both banks of the river have been submerged, except where the levees were held, and even then back water from the breaks have covered a considerable portion of the country lying along the river. At certain points between Cairo and Memphis the land is high and is never overflowed under any conditions. These places are dry for a distance of about 3 miles along the river. At Tiptonville, Tenn., there is about 12 miles of dry bank, and from Fort Pillow to Fulton, Tenn., there is about 12 miles of bluff.

The month opened with the stage of water at Memphis only 5.5 feet below the danger line, and rising at the rate of about 1 foot a day. This rise, which was first felt at Memphis on February 26, continued steadily up to the 19th of March, resulting in the most extensive and destructive overflow in the history of this section. As early as the 15th, and from that time to the end of the month, a considerable portion of that section of Arkansas and Missouri bordering on the river and extending from Cairo to Helena was flooded. At Memphis the river was about 40 miles in width. From the foot of Chickasaw bluff, upon which Memphis stands, to the high ground on Crowley's Ridge, in Arkansas, there was one sheet of water. The people inhabiting the overflowed district were forced to abandon their homes, in many cases leaving their belongings behind and gladly escaping with their lives. The work of rescue was carried on as rapidly as possible, and every available steamer was pressed into the service. It is estimated that 6,000 people and 1,200 head of stock were brought to Memphis alone, and many were carried to other places. Great suffering prevailed in the sparsely settled sections, owing to the difficulty of finding and reaching the imprisoned people, many of whom were exposed to the rain and cold for a considerable time before being discovered. Fortunately the number of deaths resulting from the flood is believed to be small. The money loss can not be estimated. The people occupying the inundated districts are largely colored, and their possessions are of small value; but the aggregate loss in that direction, while not large, falls heavily on them. The destruction of railroad property, the delay of trains and total abandonment of some lines, the suspension of business, damage to plantations, and the inability to plant the season's crop will be a serious loss to this section. The steamboat

interests have also suffered from the flood, owing to the fact that but few landings could be made, and those mostly by small boats, and to the general stagnation in business which necessarily prevails throughout the entire valley. During the last ten days of the month the seat of danger was south of Memphis, in Tunica, Bolivar, and Washington counties in Mississippi, and thence southward to Vicksburg. Through three crevasses in Bolivar County there flowed an immense stream of muddy water threatening to cover the greater portion of the Yazoo Delta, and the month closed with no indication of an abatement of the flood.

The river at Memphis during the first decade in March gained 6 feet and reached the danger line at 11 a. m. on the 9th. At 31 feet the flats were entirely covered and at 31.8 feet, which was reached on the 7th, the water went over the banks on the Arkansas side. On the 12th Hopefield, Ark., which is opposite Memphis, was submerged at a gauge reading of 34.7 feet. At noon of the 13th the water reached 35.6 feet, which is the highest point previously recorded at that place. At that stage the lowlands on the Arkansas side were covered for 20 miles inland. From the 13th to the 19th the average rise was about 0.4 of a foot daily when, owing to a break in the levee near Nodena, the river came to a stand with a gauge reading of 37.1 feet at Memphis, which is 1.5 feet above the highest ever known and 4.1 feet above danger line. The water remained stationary for three days and then began to fall very slowly, the fall up to the close of the month being 0.9 of a foot. On the 19th at 3.30 p. m. the gauge at Beal street, where all previous readings had been taken, was carried away, making it necessary to use the gauge at Elevator A. This gauge, owing to an eddy, reads 0.6 feet higher than the one at Beal street and therefore in order to make the figures harmonize with those previously announced, 0.6 of a foot was deducted from the observed readings.

From Memphis to Vicksburg the Mississippi and tributary rivers have been extremely high, reaching the highest waters ever known since the Weather Bureau records began. The most disastrous overflow of record occurred the latter part of the month by crevasses in the levees of the Yazoo Delta, causing loss of stock, crops, and other property, and the suspension of railroad traffic, but fortunately no loss of life. The amount and extent of the disaster is inestimable as the country inundated is considered the garden spot of Mississippi if not of the entire cotton region. Other crevasses were reported on the Arkansas side which caused a like disaster to the counties north of the White River. Much hardship will be the result of the floods as the water will hardly subside in time to raise a crop of cotton, the principal crop in this section. The timber interests were benefited by the high water which allowed much timber to be gotten to market. Travel by boat was the only means of reaching the river stations along the Mississippi. The new canal was used for a short cut to Yazoo City from Vicksburg.

The Mississippi south of Vicksburg rose steadily from the 1st to the close of the month, passing the danger line at Vicksburg on the 16th and at New Orleans on the 27th. The condition at the end of the month is extremely critical along this stretch of river and the levees are closely watched and strengthened at every point showing any weakness. A break in the levee occurred near Point a la Hache, below New Orleans, on the night of the 21st. No great damage resulted save that some truck and rice lands were submerged and the oyster beds in that vicinity suffered. A break occurred in the Bayou Lafourche levee near Raceland on the 30th doing some local damage, but relieving the strain on the remaining levees. The levee system from Vicksburg to New Orleans held remarkably well considering the high stage between Vicksburg and the mouth of the Red River. The rise at Vicksburg ranged from a 32.8 foot stage on the 1st to 49.4 on the 31st, and at New Orleans from 10.8 on the 1st to 17.1 on the 31st.

The Red River rose from a low stage during the early days of the month to a moderately high stage at the close, the rise at Fulton continuing from the 7th to 23d, at Shreveport from the 9th to 31st, and at Alexandria from the 13th to 31st. The month opened with water insufficient for navigation on the upper river, but conditions changed quickly on account of general rains along the upper and central Red. Considerable anxiety was felt at this time, and the additional heavy precipitation near the middle of the month awakened grave apprehensions about an overflow. At the close of the month the river was rising at the rate of about one-half foot a day, but the alarm had largely subsided. The Ouachita rose markedly between the 4th and 22d at Camden, nearly reaching the danger line. The rise at Monroe was steady and rapid from the 7th to the close of the month.

**Missouri River and branches.** (Reported by L. A. Welsh, Omaha, Nebr., and P. Connor, Kansas City, Mo.)—From the 1st of the month to the 15th the conditions of the Missouri River from its headwaters to Yankton remained unchanged. By the 18th rains and melting snow throughout South Dakota had combined to transfer the small rivers and creeks in that State into raging torrents that poured their flood into the Missouri. On the 19th the ice in the river at Yankton was covered by 10 feet of water, but still held firm. All traffic was suspended on the three railroads entering the city. The ice began breaking on the 20th, but the general breaking up of the channel ice did not occur until the 22d. The ice in the James River, which enters the Missouri just below Yankton from the north, broke up on the 29th and began running out. The "Jim" rose rapidly, covering the bottom lands of the James River valley from bluff to bluff. The farmers in this valley were pre-

pared for the flood and many had moved to high land. At Williston the water began running on the 29th and at the close of the month the ice was moving some along the banks, but the main body still remained firm and unbroken. At Pierre the ice went out on the night of the 29th, leaving the river clear at that point. On the 11th an ice gorge formed in Floyd River, which enters the Missouri at Sioux City; the gorge caused the water to overflow the Floyd bottoms and caused great uneasiness at Sioux City, but the gorge gave way in the late afternoon and the water ran out without doing any considerable damage.

The ice in the Missouri River at Sioux City broke up and ran out on the 29th without damage. At the close of the month much bottom land in the neighborhood of Sioux City is again covered by water. Both the Big Sioux and Missouri rivers are greatly swollen and are rising. The James River is especially troublesome above Vermilion. Many miles of railroad track are under water and the trains will not be running regularly again for many days. Channel ice began breaking at Omaha on the 15th. On the 16th the ice broke and moved out without damage or causing alarm. From the 16th to the 23d the river was full of running ice, and on the latter date the river reached the highest stage, 15 feet. After that date the river continued clear of ice and fell slowly but steadily. At the close of the month the stage of water at Omaha was 10.8 feet. A gorge, which had formed just below the mouth of the Platte River at Plattsmouth, gave way on the 10th, and the ice in the river at that point broke up and ran out without doing any damage. The river at Plattsmouth was clear of ice and falling slowly at the end of the month. An ice gorge that had formed at the railroad bridge at St. Joseph gave way during the forenoon of the 5th and moved out without causing damage. On and after the 17th the river at St. Joseph was clear of ice.

At Kansas City the Missouri was clear of ice the entire month, with the exception of the 2d to 4th and 9th to 11th, when there was some floating ice. It stood about the average stage for the season until the 18th, when it began to rise rapidly, reaching 18.2 feet on the morning of the 25th, 2.8 feet below the danger line; after that date it fell slowly to 14.9 feet at the close of the month. There was no damage in this vicinity, but considerable anxiety was felt because of threatening reports from Leavenworth and St. Joseph. The Missouri below Kansas City was practically free from ice during the entire month. During the early portion of the month, on account of heavy rains, there was a steady rise in all the rivers in that section. From the 4th to the 6th the Gasconade at Arlington rose 8.5 feet, and from the 4th to the 7th the Osage at Bagnell rose 20.9 feet. From the 9th to the 17th there was a steady fall in the Missouri.

**Arkansas River.** (Reported by J. J. O'Donnell, Fort Smith, Ark., and F. H. Clarke, Little Rock, Ark.)—A good navigable stage of water prevailed in the upper Arkansas River during the month, with easy access to all landings westward to Fort Gibson, of which advantage was taken by shipping from Fort Smith several thousand bags of cotton seed for planting besides other freight of a general character, but principally provisions and a large quantity of agricultural implements. Three rises occurred during the month, the second, which took place from the 17th to 20th, being more marked from the mouth of the Canadian near Webers Falls, a rise of 10 feet between that point and Fort Smith did not exceed 5 feet between Webers Falls and Fort Gibson.

The decline in the lower Arkansas River that set in on the last day of February continued interruptedly until March 5, when general rains in western Arkansas caused a rise. Continued rains over the upper watershed caused a further rise at Dardanelle and Little Rock from the 6th to the 9th. The river began falling at Fort Smith on the 9th, at Dardanelle on the 10th, and at Little Rock on the 11th, and continued to decline at all stations until the 18th, when, through moderately heavy rains in Oklahoma, Indian Territory, and Arkansas, the river began to rise quite rapidly, reaching its maximum stage of 21.4 feet at Little Rock at 1 p. m. of the 21st, being then but 1.6 feet below the danger line. It then declined steadily at all stations to the end of the month, except at Fort Smith, where a slight rise of about two feet occurred on the 31st. During the last rise of the month some fears were entertained for the safety of levees on the lower river, but ample warning of expected rise was given and the levees so strengthened that no break occurred. It is reported by the Levee Commissioners of the lower Arkansas that back water from the Mississippi River ascended the Arkansas River a distance of 95 miles by river from its mouth. Navigation was pursued uninterruptedly throughout the month and there was no overflow in the Arkansas River except at its mouth.

**Rivers on the Pacific Coast.** (Reported by W. H. Hammon, San Francisco, Cal.; J. A. Barwick, Sacramento, Cal.; and B. S. Pague, Portland, Oreg.)—From March 5 to 10 there was a moderate rise in the rivers of the Sacramento Valley, but no damage was done so far as known, since the high water of the preceding month had already overflowed all the tule lands. The Sacramento River at Sacramento has ranged during March between 18.6 feet and 20.7 feet. There have been no breaks in the levees and the water is receding slowly from the tule basin, and as the ground dries out sufficiently for plowing it is being put in condition for planting. There still remain hundreds of acres of tule lands under water, and will so remain until June or July.

During the month the rivers of the Columbia Basin were slightly above their normal March height, due to the excessive rainfall and,



east of the Cascade Mountains, to the melting of snow. Small streams, which in summer are almost dry, overflowed their banks. Little or no damage, however, was done. These small streams caused the Snake and Columbia to rise slightly, but not sufficiently to cause alarm. Navigation was uninterrupted during the entire month. The rivers were not frozen, nor was there any floating ice. The Willamette had a marked rise from the 23d, when it was 5.4 feet, to the 29th, when it was 11.8 feet. This rise was due to the melting of snow in the foot hills in connection with general rain.

#### Heights of rivers above zeros of gauges, March, 1897.

Stations.	Distance to mouth of river.	Danger-line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
<b>Mississippi River.</b>	<i>Miles.</i>	<i>Feet.</i>	<i>Feet.</i>		<i>Feet.</i>		<i>Feet.</i>	<i>Feet.</i>
St. Paul, Minn. *	1,384	14	13.5	31	3.9	30	9.6	
Reeds Landing, Minn. ....	1,864	12	8.2	31	0.3	16	2.2	7.9
La Crosse, Wis. <sup>b</sup>	1,799	10	11.2	31	3.3	18	7.9	
North McGregor, Iowa. ....	1,739	18	10.4	31	2.9	4-8	5.8	7.5
Dubuque, Iowa <sup>c</sup>	1,679	15	9.9	31	5.9	19	4.0	
Leclaire, Iowa <sup>d</sup>	1,589	10	6.5	31	0.7	7,8	3.5	5.8
Davenport, Iowa <sup>e</sup>	1,573	15	9.2	24	5.6	19	7.9	3.6
Keokuk, Iowa	1,443	14	13.4	28	2.4	7	7.5	11.0
Hannibal, Mo.	1,382	17	14.7	29	3.5	4	8.5	11.2
Grafton, Ill.	1,284	23	18.6	31	8.2	1	13.0	10.4
St. Louis, Mo.	1,241	30	23.2	28,29	12.2	2	18.7	11.0
Chester, Ill.	1,170	30	30.0	29	9.2	2	16.4	10.8
Calro, Ill.	1,073	40	51.6	26	41.1	1	48.7	10.5
Memphis, Tenn.	843	33	37.1	19-21	27.4	1	34.5	9.7
Helena, Ark.	767	44	50.9	31	34.8	1	44.7	16.1
Arkansas City, Ark.	635	42	51.9	29	35.0	1	44.5	16.9
Greenville, Miss.	595	40	46.7	29	30.2	1	38.8	16.5
Vicksburg, Miss.	474	41	49.4	31	32.8	1	41.6	16.6
New Orleans, La.	108	16	17.1	31	11.2	1	13.9	5.9
<b>Arkansas River.</b>								
Fort Smith, Ark.	345	22	17.0	20	4.4	5	9.6	12.6
Dardanelle, Ark.	250	21	18.4	20	4.5	4	10.8	13.9
Little Rock, Ark.	170	23	21.4	21	6.6	5	13.5	14.8
<b>White River.</b>								
Newport, Ark.	150	21	27.9	22	6.2	4	19.9	21.7
<b>Illinois River.</b>								
Peoria, Ill.	135	14	18.3	24-27	12.6	5	15.6	5.7
<b>Missouri River.</b>								
Bismarck, N. Dak. †	1,201	14						
Pierre, S. Dak. †	1,006	14						
Sioux City, Iowa *	676	19	14.3	21	8.8	30	5.5	
Omaha, Nebr.	561	18	15.0	23	8.1	8,9	10.3	6.9
Kansas City, Mo.	380	21	18.2	25	7.5	8-10	11.1	10.7
Boonville, Mo.	191	20	15.3	26	7.6	2-4	10.3	7.7
Hermann, Mo.	95	21	12.6	6	5.3	2	9.3	7.3
<b>Ohio River.</b>								
Pittsburg, Pa.	966	23	18.7	7	5.4	2	10.8	13.3
Davis Island Dam, Pa.	960	25	17.4	7	7.2	2	11.2	10.2
Wheeling, W. Va.	875	36	28.0	7	8.9	3	16.1	19.1
Marietta, Ohio.	795	35	29.7	8	10.5	3	17.8	19.2
Parkersburg, W. Va.	785	35	30.3	8	11.0	2,3	18.3	19.3
Point Pleasant, W. Va.	703	36	38.5	9	14.5	3	24.3	19.0
Catlettsburg, Ky.	651	50	43.0	11	19.5	4,5	31.0	23.5
Portsmouth, Ohio	612	50	45.6	11	22.2	5	33.7	23.4
Cincinnati, Ohio.	499	45	55.6	1	30.2	31	40.3	25.4
Louisville, Ky.	367	24	34.6	1	10.8	31	19.9	23.8
Kvansville, Ind.	184	30	43.6	2,3	32.3	31	40.0	11.3
Mount Vernon, Ind.	148	35	45.1	16	35.2	31	42.4	9.9
Paducah, Ky.	47	40	50.9	24,25	38.0	1	46.4	12.9
<b>Alleghany River.</b>								
Warren, Pa.	177	7	8.6	11	1.0	2	5.1	7.6
Oil City, Pa.	132	13	10.4	11	2.6	2,3	5.8	7.8
Parker, Pa.	73	20	12.7	7	3.5	2	7.8	9.2
Fresport, Pa.	26	20	20.7	6	5.9	2	11.3	14.8
<b>Conemaugh River.</b>								
Johnstown, Pa.	64	7	8.5	6	2.2	2	3.8	6.3
<b>Red Bank Creek.</b>								
Brookville, Pa.	35	8	4.8	6	1.6	30,31	2.2	3.2
<b>Beaver River.</b>								
Ellwood Junction, Pa.	10	14	6.5	7	1.6	18	2.7	4.9
<b>Big Sandy River.</b>								
Louis, Ky.	26	20	32.2	11	6.2	31	14.5	26.0
<b>Cumberland River.</b>								
Burnside, Ky.	434	50	48.1	11	5.1	30	17.4	43.0
Carthage, Tenn.	257	30	46.1	16	7.7	30	26.0	38.4
Nashville, Tenn.	175	40	48.7	21	13.8	31	32.6	34.9
<b>Great Kanawha River.</b>								
Charleston, W. Va.	61	30	14.0	21	6.2	31	9.0	7.8
<b>New River.</b>								
Radford, Va.	153	14	5.6	11	1.1	30,31	2.1	4.5
Hinton, W. Va.	95	14	7.5	15	2.8	31	4.6	4.7
<b>Licking River.</b>								
Falmouth, Ky.	30	25	17.6	10	2.8	30	7.8	14.8
<b>Miami River.</b>								
Dayton, Ohio	69	18	16.3	6	2.0	1	4.6	14.8
<b>Monongahela River.</b>								
Weston, W. Va.	161	18	4.0	18	0.0	{ 1-3, 11-17, 31 }	1.0	4.0

#### Heights of rivers above zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger-line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
<b>Monongahela River—Con.</b>	<i>Miles.</i>	<i>Feet.</i>	<i>Feet.</i>		<i>Feet.</i>		<i>Feet.</i>	<i>Feet.</i>
Fairmont, W. Va. ....	119	25	5.9	25	1.6	18	3.6	4.3
Morgantown, W. Va. ....	95	20	12.2	30	7.9	16-18	9.3	4.3
Greensboro, Pa. ....	81	18	12.8	20, 21	8.0	14-18	10.0	4.8
Lock No. 4, Pa. ....	40	28	15.3	6	8.0	18	10.8	7.3
<b>Cheat River.</b>								
Rowlesburg, W. Va. ....	36	14	6.0	6, 7, 10, 20	2.5	18	4.2	3.5
<b>Youghiogheny River.</b>								
Confluence, Pa. ....	59	10	7.9	6	2.5	31	3.5	5.4
West Newton, Pa. ....	15	23	8.0	6	1.8	18	3.8	6.3
<b>Tennessee River.</b>								
Knoxville, Tenn. ....	614	29	22.5	11	2.9	31	9.7	19.6
Rockwood, Tenn. ....	519	20	26.4	13	5.0	3, 31	13.1	21.4
Chattanooga, Tenn. ....	430	33	38.2	14	8.5	3, 31	22.0	29.7
Bridgeport, Ala. ....	390	24	27.2	16	7.0	4, 31	17.6	20.3
Florence, Ala. ....	220	16	32.5	19	8.9	6	19.4	23.6
Johnsonville, Tenn. ....	94	21	48.0	24	21.8	1	34.6	26.2
<b>Wabash River.</b>								
Terre Haute, Ind. ....	165	16	18.4	11	6.5	2, 3	12.9	11.9
Mt. Carmel, Ill. ....	50	15	26.4	13	12.4	31	20.6	14.0
<b>Red River.</b>								
Arthur City, Tex. ....	688	27	21.4	30	3.0	3-5	8.1	18.4
Fulton, Ark.	565	28	26.6	23	2.6	3-5	15.3	26.0
Shreveport, La.	449	39	19.2	31	-0.2	5	8.6	19.4
Alexandria, La.	139	33	21.3	31	2.0	13	8.9	19.3
<b>Atchafalaya River.</b>								
Melville, La.	100*	31	33.3	31	27.5	2	30.1	5.8
<b>Ouachita River.</b>								
Camden, Ark.	340	39	38.7	23	6.4	4	31.1	32.3
Monroe, La.	100	40	35.7	31	12.9	7	22.9	32.8
<b>Yazoo River.</b>								
Yazoo City, Miss.	80	25	26.0	31	14.0	1, 2	19.6	12.0
<b>Tombigbee River.</b>								
Columbus, Miss.	285	33	31.9	23	-0.6	3	18.0	32.5
Demopolis, Ala.	155	35	54.8	29	7.7	5	39.1	47.1
<b>Black Warrior River.</b>								
Cordova, Ala.	155	20	22.0	7	4.0	30, 31	12.9	28.0
Tuscaloosa, Ala.	90	38	54.8	8	8.6	3	34.0	46.2
<b>Alabama River.</b>								
Montgomery, Ala.	265	35	38.0	16	5.5	4	26.0	32.5
Selma, Ala.	212	35	41.5	26	9.5	5	31.7	32.0
<b>Coosa River.</b>								
Rome, Ga.	225	30	23.8	15	3.1	3	12.3	20.7
Wilsonville, Ala.	68	15	12.9	15	4.1	4	9.3	8.8
<b>Tallapoosa River.</b>								
Sturdevant, Ala.	69	15	11.0	13	1.2	3-5	5.4	9.8
<b>Savannah River.</b>								
Augusta, Ga.	130	32	35.2	15	9.2	6	14.0	16.0
<b>Edisto River.</b>								
Edisto, S. C.	75	6	5.7	15	4.8	12	5.3	0.9
<b>Congaree River.</b>								
Columbia, S. C.	37	15	12.0	15	1.4	6	4.2	10.6
<b>Santee River.</b>								
St. Stephens, S. C.	50	12	11.6	23	8.3	12, 13	9.3	3.3
<b>Watauga River.</b>								
Camden, S. C.	45	24	25.8	15	7.0	6	14.3	18.8
<b>Black River.</b>								
Kingstree, S. C.	60	12	9.9	6	8.0	31	8.9	1.9
<b>Great Pee Dee River.</b>								
Cheraw, S. C.	145	27	29.5	15	4.4	30	14.4	25.1
<b>Lincoln Creek.</b>								
Effingham, S. C.	35	12	12.3	1, 23	7.8	12	10.2	4.5
<b>Lumber River.</b>								
Fairbluff, N. C.	10	6	6.6	1-3	5.0	31	5.9	1.6
<b>Waccamaw River.</b>								
Conway, S. C.	40	7	7.3	7, 8	4.6	31	6.4	2.7
<b>Cape Fear River.</b>								
Fayetteville, N. C.	100	38	37.6	16, 17	7.2	30, 31	17.6	30.4
<b>James River.</b>								
Lynchburg, Va.	257	18	5.6	15	1.8	31	3.0	3.8
Richmond, Va.	110	12	3.7	17, 31	0.5	31	2.0	3.2
<b>Potomac River.</b>								
Harpers Ferry, W. Va.	170	16	7.6	21	3.4	3, 4	5.1	4.2
<b>Susquehanna River.</b>								
Wilkesbarre, Pa.	178	14	13.0	26	1.0	3	6.1	12.0
Harrisburg, Pa.	70	17	11.5	26	3.2	3	7.1	8.3
<b>W. Br. of Susquehanna.</b>								
Lock Haven, Pa.	63	10	5.5	7	1.5	1, 2	3.4	4.0
Williamsport, Pa.	35	20	11.2	25	3.1	3	7.2	8.1
<b>Juniata River.</b>								
Huntingdon, Pa.	80	24	6.9	6	4.0	2	5.3	2.9
<b>Sacramento River.</b>								
Redbluff, Cal.	241	23	13.6	1	4.6	22	7.0	9.0
Sacramento, Cal.	70	23	20.7	8	18.6	25-27	19.8	2.